Aug. 30, 1949. H. J. FINDLEY 2,480,405

THERMOELECTRIC RADIO OPERATION

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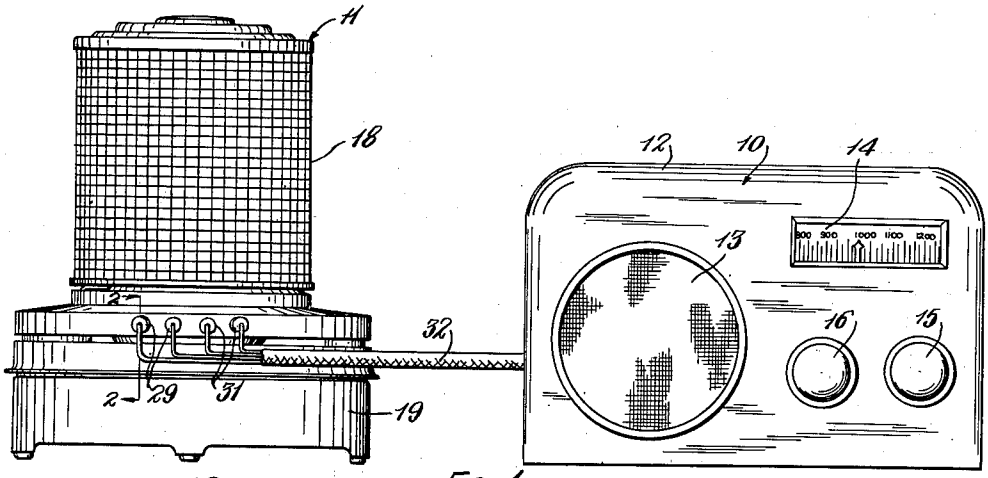

FIG. 1

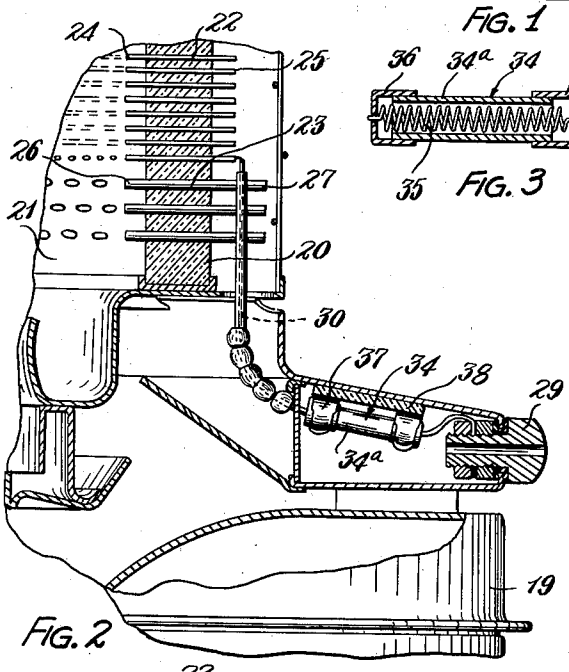

FIG. 2

FIG. 3

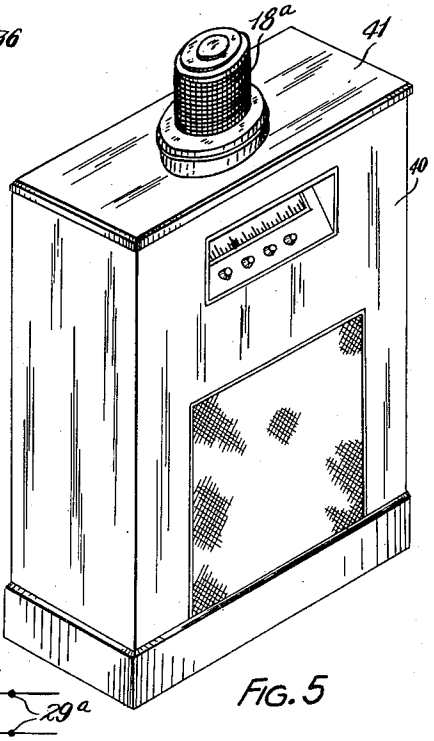

FIG. 5

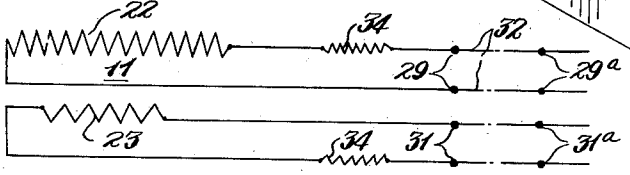

FIG. 4

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THERMOELECTRIC RADIO OPERATION

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5 Claims. (Cl. 250—27)

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This invention has to do with the operation of radio apparatus by the use of electric energy generated thermoelectrically and, as one of its objects, aims to provide an improved apparatus and circuit by which this can be carried out in a safe, efficient and satisfactory manner.

In operating a radio apparatus directly from a thermoelectric generator as a source of energizing current, an important problem is presented in that the terminal voltage of the current delivered by this type of generator is usually subject to fluctuations and to undesirable increases which may have a damaging or aging effect on the electron tubes embodied in the radio apparatus. These voltage increases have been found to occur from various causes, such as air drafts and variations in the rate of fuel combustion, and may occur either suddenly or gradually and at irregular intervals and although they can be substantially eliminated by manually adjusting the operation of the generator, this is very tedious and troublesome. If these voltage increases are ignored they may result in a condition in which the electron tubes of the radio apparatus are being operated at voltages above their rated values which is undesirable because it will materially shorten their useful life.

The present invention successfully meets this problem by providing control means in a thermoelectrically operated radio apparatus which will function to automatically produce a smoothing effect on undesirable voltage fluctuations, and particularly on undesirable voltage increases, in current being supplied directly to the radio apparatus from a thermoelectric generator.

Another object of the invention is to provide improved thermoelectric radio apparatus of this character, in which the voltage control means is a unit located in the generator-radio circuit and having a positive temperature coefficient of resistance.

Still another object of this invention is to provide improved apparatus of this character, in which a radio apparatus having an "A" circuit is connected for energization directly from a thermoelectric generator and is protected against the harmful effects of undesirable voltage increases by an electrically conducting control means having a positive temperature coefficient of resistance.

A further object of the invention is to provide improved apparatus of this character, in which the radio apparatus has both "A" and "B" circuits connected for energization directly from a thermoelectric generator and electrically conducting control members having a positive temperature coefficient of resistance are employed in the connections between the generator and said "A" and "B" circuits.

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The invention can be further briefly summarized as consisting in certain novel combinations and arrangements of parts hereinafter described and particularly set out in the appended claims.

In the accompanying sheet of drawings:

Fig. 1 is an elevational view showing a radio apparatus directly energized from a thermoelectric generator and protected from undesirable voltage variations in accordance with the present invention.

Fig. 2 is a partial vertical sectional view, on a larger scale, taken through the thermoelectric generator substantially as indicated by 2—2 in Fig. 1 and showing the voltage control means.

Fig. 3 is a detached sectional view taken through the voltage control means.

Fig. 4 is a schematic wiring diagram further illustrating the use of the control means in the circuits connecting the thermoelectric generator with the radio apparatus, and

Fig. 5 is a perspective view showing a modification in which the thermoelectric generator is supported by the radio apparatus.

In the thermoelectric radio operation contemplated in this application a radio apparatus, such as the radio receiving device 10, is connected with a thermoelectric generator 11 as a source of power and is energized directly therefrom. The radio apparatus 10 can be of a conventional type having a suitable cabinet or housing 12 in which are located a loud speaker 13 and conventional electron tube circuits for rendering the loud speaker 13 operable to reproduce broadcast programs or other radio signals. The radio apparatus 10 is also shown as having the conventional tuning dial 14 and control knobs 15 and 16. The electron tube circuits of the radio apparatus 10 may include conventional circuits of the kind known as "A" and "B" circuits and which are adapted to be energized from an external power source with electric current of appropriate voltages. As is understood by those skilled in the radio art an "A" circuit is an electron tube filament, or filament heater, circuit and a "B" circuit is an electron tube plate circuit.

The thermoelectric generator 11 may be of an appropriate construction for delivering the current values and terminal voltages needed for energizing the various circuits of the radio apparatus 10, including the above mentioned "A"

and "B" electron tube circuits. The thermoelectric generator 11 is here shown as having an upright hollow thermopile 18 which is supported on the base 19 and extends thereabove. The thermoelectric generator 11 is disclosed more in detail in copending application Serial No. 606,121, filed July 20, 1945.

For the purposes of the present invention it is sufficient to explain that the thermopile 18 of the generator 11 has an upright tubular insulating body 20 which forms a stack and whose passage defines a combustion chamber 21. The thermopile also includes one or more groups of thermocouple elements which are supported by the wall of the hollow insulating body 20 and extend therethrough. In this instance the thermopile is shown as having two such groups of thermocouple elements 22 and 23, of which the elements 22 are very numerous and are made of wire of a relatively small cross-sectional area. The elements 23 are relatively few in number and are made of wire of a relatively larger cross-sectional area. The thermocouple elements 22 are spaced along and around the insulating wall 20 and have hot and cold junctions 24 and 25 which are located, respectively, inside and outside of the combustion chamber 21. Likewise the thermocouple elements 23 have hot and cold junctions 26 and 27 which are also located inside and outside of the combustion chamber 21. The base 19 of the generator embodies suitable fuel burning means for supplying heat to the thermopile 18 and operates so as to cause heated combustion gases to travel upwardly through the combustion chamber 21 and heat the hot junctions of the thermocouples 26 and 24 while the cold junctions 27 and 25 are being cooled by contact with the atmosphere or air currents circulating about the generator.

The thermocouple elements 22 are provided in suitable number to deliver a terminal voltage and current value appropriate for energizing the "B" circuit of the radio apparatus 10. Likewise the thermocouple elements 23 are provided in suitable number to deliver an appropriate terminal voltage and current value for energizing the "A" circuit of the radio apparatus. The generator 11 is here shown as having a pair of "B" terminal connections 29 which are connected with the group of thermocouple elements 22 by suitable lead wires 30 and a pair of "A" terminals 31 which are similarly connected with the group of thermocouple elements 23. As shown in Figs. 1 and 4, the "B" and "A" terminals of the generator 11 are connected with the corresponding "B" and "A" terminals of the radio apparatus 10 by a conductor cord 32 having a suitable group of individual conductors therein. The "B" and "A" terminals of the radio apparatus are indicated in Fig. 4 by the reference characters 29a and 31a, respectively.

As indicated above, it is characteristic of thermoelectric generators, such as the generator 11 herein disclosed, that fluctuations may occur in the terminal voltages being delivered as changes occur in the operating conditions of the generator. These changes may be produced by variations in the rate of fuel combustion which, in turn, is dependent upon numerous variable operating factors of the fuel burning means. These changes may be due in part to air drafts which affect the operation of the fuel burning means and which may in other ways also disturb the temperature differential between the hot and cold junctions of the generator. When these fluctuations in the rate of power delivery of the

thermoelectric generator are increases in the terminal voltage or voltages above the rated voltage characteristics for which the electron tubes of the radio apparatus 10 have been designed, an operating condition may result in which the life of the electron tube is materially shortened. This is particularly true for undesirable increases in the voltage being supplied to the "A" circuits of the electron tubes.

To protect the electron tubes of the radio apparatus 10 against the voltage fluctuations of the thermoelectric generator 11 and particularly against undesirable increases in the terminal voltage of the generator, a voltage control means is provided in the circuit connections between the generator and the radio apparatus 10. This voltage control means is here shown as being embodied in the thermoelectric generator 11 and comprises a member 34 having a relatively high positive temperature coefficient of resistance. The control means 34 is used primarily in the connections for the "A" circuits of the radio apparatus although this control means can be located in the connections for the "B" circuits alone or in both the "A" and "B" circuits as shown in Fig. 4.

The voltage control member 34 comprises a resistor 35 made of any suitable material which will provide a positive temperature coefficient of resistance of the correct value and which will produce the effect of smoothing out the undesirable voltage fluctuations in the current being delivered by the thermoelectric generator 11. The resistor 35 can, for example, be made of iron wire and may have a length and cross-sectional area appropriate for producing the regulating effect desired. In this instance, the resistor 35 is housed in a tube 34a made of fiber or other electrically insulating material. The ends of the resistor 35 are connected with metal caps 36 which are mounted on the ends of the insulating tube 34a and are engageable in terminal clips 37, as shown in Fig. 2. The terminal clips 37 are carried by an insulating base 38 which can be suitably located and, in this instance, is mounted on the wall of the thermoelectric generator 11.

Fig. 5 of the drawing shows a modified construction in which the radio apparatus is located in a cabinet 40 and the thermoelectric generator 18a is supported by or mounted on such cabinet. In this instance, the radio cabinet 40 is shown as having a substantially flat top 41 on which the thermoelectric generator 18a is adapted to stand or rest. The generator 18a is connected with the circuits of the radio apparatus by circuit similar to those illustrated in Fig. 4 and which include the voltage regulating member or members 34.

From the foregoing description and the accompanying drawing, it will now be readily understood that this invention provides for an improved thermoelectric radio operation in which the radio apparatus is protected against undesirable voltage variations in energizing current being supplied directly to the radio apparatus by a thermoelectric generator.

Although the improved apparatus is illustrated and described herein in some detail, it will be understood of course that the invention is not to be regarded as being correspondingly limited but is intended to include all changes and modifications coming within the scope of the appended claims.

Having thus described my invention, I claim:

1. In combination, a radio receiver apparatus of the electron tube type adapted to be energized from an external power source, a thermoelectric

generator operable to deliver a terminal voltage suitable for energizing said radio apparatus but which is subject to fluctuation in response to variations in the operating conditions of the generator, means connecting said radio apparatus in circuit with said generator to be operably energized directly therefrom, and temperature responsive voltage control means of the resistor type in said circuit and operable automatically to produce a smoothing effect on said fluctuation so as to protect the electron tubes from being operated at voltage values which would shorten their useful life.

2. In combination, a radio receiver apparatus, a thermoelectric generator, means connecting said generator in circuit with said radio apparatus for operably energizing the latter directly from said generator, and control means of the resistor type in said circuit having a positive temperature coefficient of resistance.

3. In combination, a radio receiver apparatus having an electron tube circuit, a thermoelectric generator of the fuel burning type, means connecting said generator with said circuit for directly and operably energizing the latter therefrom, and control means of the resistor type in said circuit having a positive temperature coefficient of resistance for protecting the electron tube or tubes against a predetermined voltage increase.

4. In combination, a radio receiver apparatus having circuits including an electron tube filament heater circuit, a thermoelectric generator of the fuel burning type operable to produce current of a potential suitable for energizing said filament heater circuit, and means connecting said generator directly and operably with said filament heater circuit and including a control member of the resistor type having a positive temperature coefficient of resistance.

5. In combination, a radio receiver apparatus

having an electron tube filament heater circuit and an electron tube plate supply circuit, a theromelectric generator of the fuel burning type having generating units operable to produce terminal voltages and current values suitable for energizing said filament heater and plate supply circuits respectively, and means connecting said units directly and operably with the respective filament heater and plate supply circuits and including for each of said circuits a control member of the resistor type having a positive temperature coefficient of resistance.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,256,223	Grob	Feb. 12, 1918
1,286,429	Shindel	Dec. 3, 1918
1,666,919	Steurer	Apr. 24, 1928
1,677,029	Fuller et al.	July 10, 1928
1,774,720	Mieville	Sept. 2, 1930
2,162,976	Schroter	June 20, 1939
2,312,022	Brooks	Feb. 23, 1943
2,346,654	Leuthold	Apr. 18, 1944
2,386,903	Lutomirski	Aug. 27, 1945
2,406,715	Strickland, Jr.	Aug. 27, 1946
2,413,021	Wolfson et al.	Dec. 24, 1946

FOREIGN PATENTS

Number	Country	Date
268,106	Germany	Dec. 8, 1913
586,951	France	Apr. 7, 1925
602,377	France	Mar. 17, 1926

OTHER REFERENCES

Milnes, Thermo-electric Generator, 1933, 136–4 (p. 7, 8).